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(56)参考文献　特開　昭58－104160（ＪＰ，Ａ）
特開　昭62－13533（ＪＰ，Ａ）
特開　昭63－14817（ＪＰ，Ａ）
特開　昭53－25211（ＪＰ，Ａ）

(54)【発明の名称】　高周波焼入により製造される車体補強電縫鋼管用熱延鋼材の製造方法

1

【特許請求の範囲】

【請求項１】C:0.15～0.25%（重量%、以下同じ）

Mn≦1.5%

Si≦0.5%

Ti≦0.04%

B:0.0003～0.0035%

N≦0.0080%

を含有し、さらに

Ni≦0.5%

Cr≦0.5%

Mo≦0.5%

の一種または二種以上を含有し、残部Feおよび不可避的不純物よりなる鋼を素材とし、熱間圧延後600℃以上で巻取ることを特徴とする高周波焼入により製造される車体補強電縫鋼管用熱延鋼材の製造方法。

2

【発明の詳細な説明】

（産業上の利用分野）

本発明は特に高強度を必要とする車体補強鋼管、例えば自動車側面衝突時の運転者の安全性を確保するためのドア補強鋼管であるドアインパクトバー、あるいはバンパー用芯材等の高強度を要求される車体補強電縫鋼管、特に高周波焼入により製造される車体補強電縫鋼管用熱延鋼材の製造方法に関する。

（従来の技術）

自動車車体補強部材、例えばインパクトビームとして用いる材料には、衝突時の乗員の安全性確保のため、高強度であることと同時に衝突時に大きな塑性変形を受けても破断を起こして急激に強度が低下することがないようにすること、そして低温でもこの特性を確保することが必要である。このように、自動車車体補強部材にとって

は強度、延性、低温靭性は重要な特性である。

高強度な電縫鋼管の製造方法としては、特公昭56－46538号公報に記載された高張力電縫鋼管の製造方法が知られている。該方法では、延性を確保するために焼戻処理を施しており、一般に焼入焼戻処理は鋼管の靭性・延性の回復のために必要であった。しかしながら、焼戻処理を施すと強度が大幅に低下するため、例えば120kgf/mm²以上という高強度の鋼管を得るのは困難であった。かかる高強度鋼管を得ようとする場合には、高周波焼入ままで使用するのが好ましいが、この場合は靭性が劣化する。そこで、高周波焼入ままで靭性を向上させようとすると、低炭素化を図れば良いが、このときは高周波焼入時の冷却速度によって強度のバラツキがきわめて大きくなり実用性能として問題が生じてくる。

（発明が解決しようとする課題）

本発明は、前記の如くインパクトビーム用鋼管のように高強度、高靭性、高延性が必要な鋼管を製造するに際し低成分化し、高周波焼入ままで使用するような場合において、焼きが入りにくい、強度バラツキが大きいなどの問題を解決するためになされたものである。

（課題を解決するための手段）

本発明の要旨とするところは、

C:0.15～0.25%（重量%、以下同じ）

Mn≦1.5%

Si≦0.5%

Ti≦0.04%

B:0.0003～0.0035%

N≦0.0080%

を含有し、さらに

Ni≦0.5%

Cr≦0.5%

Mo≦0.5%

の一種または二種以上を含有し、残部Feおよび不可避的不純物よりなる鋼を素材とし、熱間圧延後600℃以上で巻取ることを特徴とする高周波焼入により製造される車体補強電縫鋼管用熱延鋼材の製造方法にある。

（作用）

本発明は、上記課題を解決するためになされたもので、成分・熱延条件を選定することにより、その後電縫管とする際の造管性は従来の低強度鋼管と同等で、電縫鋼管とした後に高周波焼入処理を行うことにより、良好な伸び・靭性を示す高強度車体補強電縫鋼管を得ることができる熱延鋼材を提供する。

以下本発明における熱延鋼材製造条件の限定理由について述べる。

まず、成分系であるが、本発明は、最終製品の車体補強電縫鋼管の時点では焼入マルテンサイト組織による強化をめざしたもので、焼入ままのマルテンサイト組織の強度はC含有量によって決定される。これは変態の利用により過飽和に導入される固溶Cが支配要因となっている

と考えられる。自動車車体補強電縫鋼管として好ましい120kgf/mm²以上の強度を確保するためには、第1図に示すごとくCは0.15%以上が必要である。一方、C量を増やしていくと延性の劣化が顕著となる。10%程度以上の伸びを確保するには、Cは0.25%以下とすることが必要である。第2図に炭素量に対する高周波焼入材の靭性を示す。C0.25%以下で靭性を高く保つことができる。

以上のように本発明においては、炭素量の効果を詳細に調べることにより、0.15%≦C≦0.25%の範囲で、高周波焼入処理後の高強度と高靭性・高延性を達成することができ、車体補強電縫鋼管として有効な特性が得られる。

Mnは鋼のマルテンサイト変態温度を低下させ、焼入性を向上させるとともに、焼入処理途中にて変態後のセルフテンパーを回避し、強度を高く保つ効果を持つことができる元素である。ただし、Mnは、例えば電縫溶接にて鋼管を製造する場合を想定すると溶接欠陥を生じ易く、その含有量は1.50%が上限である。

Ni,Cr,MoはMnに比べ、非常に高価であるが、Mnの他にこれらNi,Cr,Moを単独または複合添加すると、マルテンサイト変態温度を低下させ、セルフテンパーを回避し、高強度化により効果を発揮するものである。溶接性を確保するため上限はそれぞれ0.5%とする。

Siについては、Mnとともに電縫溶接にて鋼管を製造する場合に、溶接部の健全性を維持するうえで非常に重要な元素である。Siの上限は、溶接部にてペネトレーターと呼ばれる酸化物を形成しないようにするため0.5%以下とする。Mn/Si比のバランスを、3～10とするのが望ましい。

Bは、焼入性を飛躍的に向上させる元素で、本発明の鋼種の場合、比較的低Cにてマルテンサイト分率90%以上を得るため、B添加を特徴としているが、0.0003%未満では、焼入性向上効果が得られず、また0.0035%を超える場合は、コスト高になるばかりでなく、表面疵や靭性劣化の原因となり易い。従って、Bの添加は0.0003～0.0035%とした。

このBの焼入性向上効果は、Nが0.003%以上存在すると失われるので、このNの固定化の目的でTiの添加を行う。添加するTiの量は0.04%を超えると疵の発生、切削性の劣化等品質面でトラブルを生じ易く、従ってTiは0.04%以下に規制する。

尚、Nは不可避的に鋼中に存在し、BNを形成し、Bの効果を軽減してしまう。そこで、Nは極力軽減するのが望ましく、上限を0.0080%とする。

次に、熱延条件の限定理由であるが、本発明において詳細に巻取温度の検討を実施した結果、第3図に示す結果が得られた。横軸は巻取温度、縦軸は熱延鋼材より電縫鋼管とした後高周波焼入処理を実施した場合の鋼管強度特性であり、600℃未満の巻取温度では、強度のバラツキが非常に大きくなる。すべて同一成分で同一の高周波

焼入処理を実施した場合の例で、焼きの十分入った場合の強度は、巻取温度によらずほぼ一定であるものの、巻取温度が600℃未満では、部分的に焼入れ不十分な組織を形成し、強度バラツキが大きく、高強度を安定して確保するためには不適切である。逆に600℃以上の巻取温度では、熱延鋼材段階で比較的均一で粗いフェライト・パーライト組織を形成しており、造管後焼きを入れた場合、十分な焼きが入りバラツキの少ない強度特性が得られる。

さらに、熱延鋼材を電縫鋼管とする場合の造管性からも600℃以上の巻取温度とする。ここで言う造管性というのは、熱延鋼材のハンドリングのしやすさ、成形のしやすさ、電縫溶接のしやすさを指す。本発明の出発材は、炭素量は極力軽減しているが、Bの添加等にて焼入性を高くしているため、熱延の巻取温度の低温化にて容易に高強度な熱延鋼材が得られてしまう。高強度な鋼材になると熱延鋼材から電縫鋼管用鋼帯にするせん断加工の際の刃物の寿命の短期化、巻取・巻戻し力の上昇といったハンドリングの難しさ、材料の降伏強度の上昇により成形反力の増大、バックリング量の増大による定型の困難さ、成形の難しさと同時に電縫溶接品質に影響を及ぼす電縫溶接給電部の形状不安定化を生じ溶接品質安定が難しくなる。

これに対して巻取温度を600℃以上とすると、第4図に示す如く一般の電縫鋼管の強度水準である40kgf/mm²から60kgf/mm²程度の熱延鋼材となり、通常の電縫鋼管と変わらない状態にて電縫溶接が可能である。

さらに、造管性に悪影響を与える要因として、素材強度のバラツキがある。インパクトビーム用素材は薄肉材料が多く、熱延後の温度降下は比較的速い。その結果冷却条件の微妙な違いにより巻取温度に影響を生じ易く、600℃未満の場合素材強度は巻取温度の変化に対応して大きく変化し、その後の造管での成形の安定性、さらには電縫溶接の安定性に悪影響を及ぼす。第3図に示す如く600℃以上では、巻取温度に対する素材強度のバラツキ範囲は非常に少なく、600℃以上の巻取温度とすることにより良好な造管性が得られる。

以上のような成分・熱延条件にて製造した熱延鋼材は、電縫鋼管とするのが容易であり、電縫鋼管としたのち、

高周波焼入処理を実施することにより引張強さ120kgf/mm²以上で、延性・靭性に優れ、車体補強電縫鋼管として良好な性能を示す。

（実施例）

第1表に本発明の実施例および比較例を示す。本発明の製造方法による熱延鋼板のJIS 5号引張り特性及び当該熱延鋼板を外径31.8mm×肉厚2.0mmの電縫鋼管とした後の熱処理方法、及び熱処理後のJIS 11号引張り特性、シャルピー吸収エネルギーを第1表に併せて示す。ここで、シャルピー吸収エネルギーは、靭性評価用に専用に作製したフルサイズの試験片にて得たデータを示す。

実施例A～Fではいずれの場合も熱延鋼材にて引張強度60kgf/mm²程度以下で造管の際特に大きな問題を生じなかった。電縫鋼管とした後高周波焼入処理を実施することによりいずれの場合も120kgf/mm²以上、伸び10%程度、吸収エネルギー2kgf－m/cm²程度以上が得られ、しかも引張強度のバラツキは数kgf/mm²以下と均一な組織の電縫鋼管が得られた。

比較例GはC含有量が本発明成分範囲より低い場合、電縫鋼管とした後の高周波焼入処理によって、最終目標の強度が得られない。

比較例HはC量が本発明成分範囲より高い場合で、電縫鋼管の高周波焼入処理後、強度は十分達成できるものの、伸びが非常に低い状態である。

比較例I～Mは600℃未満の低温巻取を実施した場合であるが、最終的電縫鋼管の特性としては比較的高強度・高延性・高靭性は達成できるものの、その強度バラツキは20kgf/mm²近くあり、車体補強鋼管として安定した特性を確保し難い。また、熱延鋼材段階にて高強度であり、造管性で劣る。比較例I,K,Lは通常ラインで電縫鋼管とした際、せん断工程の丸刃の欠損にて、せん断品質を良好に保つのが難しく、電縫鋼管化する場合特殊な対策を要する。また、比較例J,Mは素材の強度は若干低下され、せん断丸刃の寿命の問題はあるものの、比較的良好なせん断品質が得られた。ただし、鋼帯先後端部のハンドリングの困難さ、電縫鋼管成形の際の反力が高く、調整等の負荷が増え、通常強度材より生産性の低下が顕著である。

第　1　表

（化学成分wt%）

鋼No.	C	Si	Mn	P	S	Ti	B	N	Al	Ni	Cr	Mo	熱延鋼板 巻取温度 (℃)	熱延鋼板 引張強さ kgf/mm²	熱延鋼板 造管性	電縫鋼管 焼入方法	電縫鋼管 ΔTS(N=5) バラツキ TS max－TS min	電縫鋼管 引張り強さ kgf/mm²	電縫鋼管 降伏強度 kgf/mm²	電縫鋼管 伸び %	電縫鋼管 vE－20 kgf－m/cm²	備考
A	0.16	0.18	1.12	0.018	0.004	0.022	0.0011	0.0051	0.026	－	0.22	－	620	52.0	○	高周波	6.2	135.2	102.5	17.0	7.9	本発明
B	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	－	0.23	－	620	53.0	○	高周波	4.3	158.0	115.0	16.0	5.9	本発明
C	0.22	0.21	1.18	0.018	0.004	0.021	0.0011	0.0045	0.028	－	0.22	－	650	58.0	○	高周波	5.2	163.2	122.5	13.0	4.0	本発明
D	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	0.50	0.20	0.2	620	55.0	○	高周波	3.7	159.0	112.0	17.0	6.9	本発明
E	0.18	0.20	1.15	0.016	0.004	0.021	0.0012	0.0053	0.024	－	0.40	0.2	650	59.0	○	高周波	4.5	158.5	114.0	16.0	5.7	本発明
F	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	0.50	－	－	650	55.0	○	高周波	2.2	155.0	109.0	18.0	7.1	本発明
G	0.14	0.19	1.13	0.017	0.004	0.022	0.0011	0.0051	0.026	－	0.22	－	650	48.0	○	高周波	8.5	110.5	90.2	19.0	8.3	比較例
H	0.27	0.21	1.18	0.018	0.004	0.021	0.0011	0.0045	0.028	－	0.22	－	650	58.0	○	高周波	10.2	172.2	130.5	7.0	1.5	比較例
I	0.22	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	－	0.23	－	200	142.0	×	高周波	19.5	158.0	121.0	11.0	3.3	比較例
J	0.21	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	400	95.0	△	高周波	21.0	150.1	123.3	11.5	3.2	比較例
K	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	30	140.0	×	高周波	23.5	143.5	109.5	11.5	4.9	比較例
L	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	200	139.0	×	高周波	21.5	142.2	107.2	11.0	4.0	比較例
M	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	400	95.0	△	高周波	18.0	149.5	105.5	12.0	2.7	比較例

vE－20：－20℃におけるシャルピー吸収エネルギー

（発明の効果）

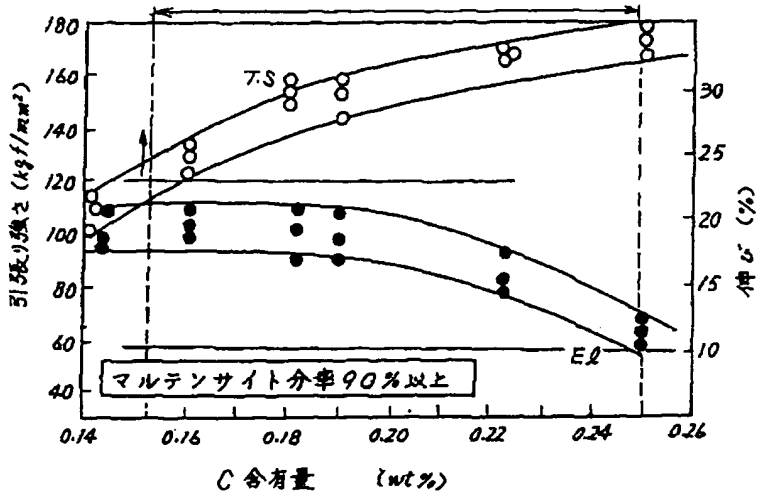
以上説明したように、本発明によれば、車体補強電縫鋼管として有用な、伸び・靭性に優れた引張強さ120kgf/mm²以上の高強度電縫鋼管用素材であって、しかも電縫鋼

管とする際の作業負荷が従来の低強度材と何等変わらない熱延鋼材を製造することができる。

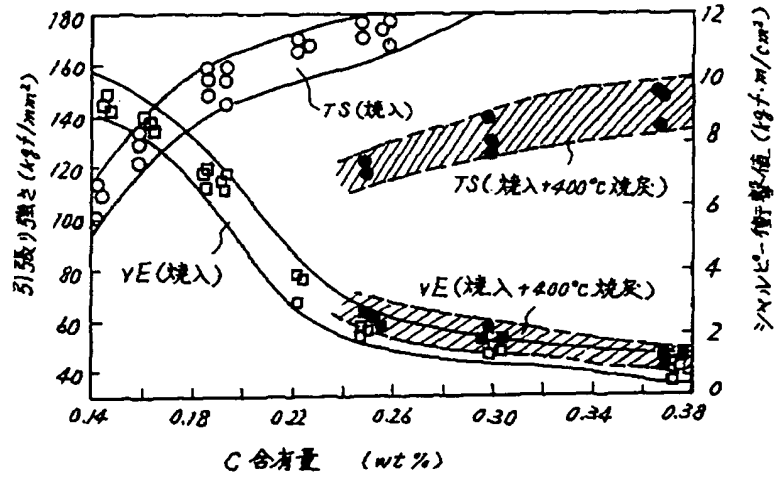
【図面の簡単な説明】

第1図は熱延鋼材の炭素含有量が、高周波焼入処理後の最終的な電縫鋼管の引張り特性に対する影響を示す図、＊第2図は熱延鋼材の炭素含有量が、高周波焼入処理後の最終的な電縫鋼管の引張り強さ、シャルピー衝撃値に対する影響を示す図、第3図は高周波焼入後の強度特性に対する巻取温度条件の影響を示す図、第4図は巻取温度の熱延鋼材の引張り強さに対する効果を示す図である。

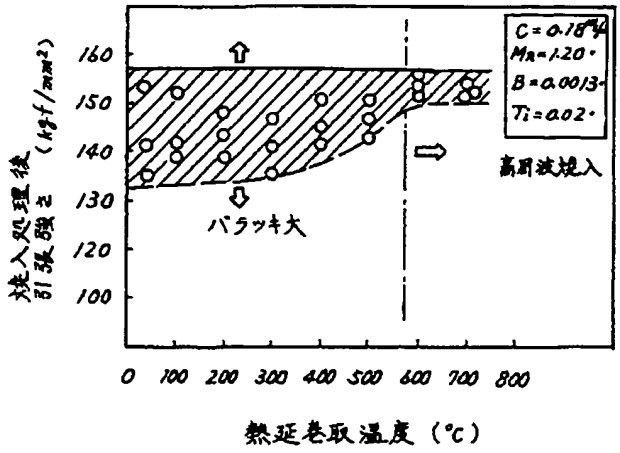
【第1図】



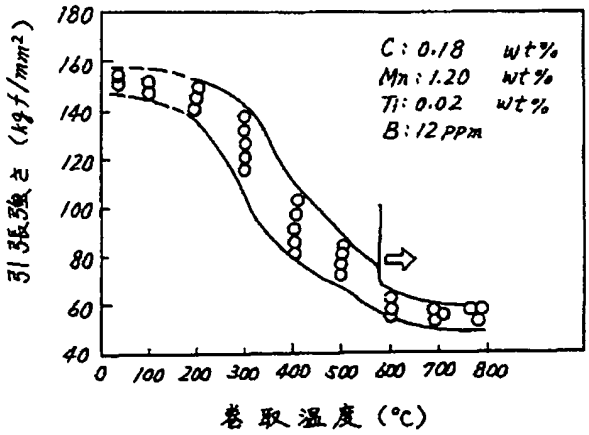
【第2図】



【第3図】


焼入処理後
引張強さ (kgf/mm²)
160
150
140
130
120
100
C=0.18%
Mn=1.20%
B=0.0013%
Ti=0.02%
高周波焼入
バラツキ大
0 100 200 300 400 500 600 700 800
熱延巻取温度 (℃)

【第4図】


引張強さ (kgf/mm²)
180
160
140
120
100
80
60
40
C : 0.18 wt%
Mn : 1.20 wt%
Ti : 0.02 wt%
B : 12 ppm
0 100 200 300 400 500 600 700 800
巻取温度 (℃)

JAPANESE [JP,07-074382,B]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] C:0.15 - 0.25% (it is below the same% of the weight)
The manufacture approach of the hot-rolling steel materials for car-body reinforcement electroseamed steel pipes manufactured by high-frequency induction hardening which contains Mn<=1.5%Si<=0.5%Ti<=0.04%B:0.0003-0.0035%N<=0.0080%, contains a nickel<=0.5%Cr<=0.5%Mo<=0.5% kind or two sorts or more further, is made from the steel which consists of the remainder Fe and an unescapable impurity, and is characterized by rolling round above 600 degrees C after hot rolling.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
(Field of the invention on industry)
Especially this invention relates to the manufacture approach of the hot-rolling steel for car-body reinforcement electroseamed steel pipes manufactured by the car-body reinforcement electroseamed steel pipe of which high intensity, such as a door impact bar which is a door reinforcement steel pipe for securing the safety of the car-body reinforcement steel pipe which needs high intensity, for example, the operator at the time of an automobile side collision, or a core material for bumpers, is required, especially high-frequency induction hardening.
(Prior art)
It is required for the ingredient used as an automobile car-body reinforcement member, for example, an impact beam, to cause fracture and to make it reinforcement not fall rapidly, even if it receives big plastic deformation in that it is high intensity and coincidence at the time of a collision, and to secure this property also at low temperature because of safety reservation of the crew at the time of a collision. Thus, for an automobile car-body reinforcement member, reinforcement, ductility, and low-temperature toughness are important properties.
As the manufacture approach of a high intensity electroseamed steel pipe, the manufacture approach of the high tension electroseamed steel pipe indicated by JP,56-46538,B is learned. In order to secure ductility, temper processing had been performed, and generally quenching temper processing was required of this approach because of recovery of a steel pipe of toughness and ductility. However, since reinforcement would fall substantially if temper processing is performed, it was difficult to obtain the steel pipe of high intensity called two or more [120 kgf(s)/mm]. Although it is desirable to use it as [high-frequency-induction-hardening] when it is going to obtain this high-strength steel tubing, toughness deteriorates in this case. Then, although what is necessary is just to attain low carbon-ization if it is going to raise toughness as [high-frequency-induction-hardening], at this time, with the cooling rate at the time of high frequency quenching, the variation in strong becomes very large and a problem arises as practicability ability.
(Technical problem which invention tends to solve)
This invention is made in order to solve problems, like that it faces manufacturing the steel pipe which needs high intensity, high toughness, and high ductility like the steel pipe for impact beams like the above, a low component is formed, and baking cannot enter easily when it is as [high frequency quenching] and uses it, and variation on the strength is large.
(The means for solving a technical problem)
The place made into the summary of this invention is C:0.15 - 0.25% (it is below the same% of the weight).
It is in the manufacture approach of the hot-rolling steel for car-body reinforcement electroseamed steel pipes manufactured by high-frequency induction hardening which contains Mn<=1.5%Si<=0.5%Ti<=0.04%B:0.0003-0.0035%N<=0.0080%, contains a nickel<=0.5%Cr<=0.5% Mo<=0.5% kind or two sorts or more further, is made from the steel which consists of the remainder Fe and an unescapable impurity, and is characterized by rolling round above 600 degrees C after hot rolling.

(Operation)
By having been made in order to solve the above-mentioned technical problem, and selecting a component and hot-rolling conditions, the tubulation nature of this invention at the time of considering as a welded tube after that is equivalent to the conventional low-strength steel pipe, and after considering as an electroseamed steel pipe, it offers the hot-rolling steel which can obtain the high intensity car-body reinforcement electroseamed steel pipe in which good elongation and toughness are shown by performing high-frequency-induction-hardening processing.
The reason for definition of the hot-rolling steel manufacture conditions in this invention is explained below.
First, although it is a component system, this invention is what aimed at the consolidation by quenching martensitic structure at the event of the car-body reinforcement electroseamed steel pipe of a final product, and the reinforcement of the martensitic structure of a quenching as is determined by C content. This is considered that the dissolution C introduced into supersaturation by utilization of a transformation causes rule. In order to secure 120 kgf(s)/mm two or more reinforcement desirable as an automobile car-body reinforcement electroseamed steel pipe, as shown in drawing 1 , 0.15% or more of C is required. On the other hand, an increase and degradation of ductility [carry out] become remarkable about the amount of C. In order to secure about 10% or more of elongation, C needs to consider as 0.25% or less. The toughness of the high-frequency-induction-hardening material to a carbon content is shown in drawing 2 . Toughness can be kept high less than [C0.25%].
As mentioned above, by investigating the effectiveness of a carbon content in a detail in this invention, it is 0.15% <= C<=0.25% of range, and the high intensity after high-frequency-induction-hardening processing, and high toughness and high ductility can be attained, and the effective property as a car-body reinforcement electroseamed steel pipe is acquired.
Mn is the element which can have the effectiveness which avoids the self temper after a transformation in the middle of quenching treatment, and keeps reinforcement high while it reduces the martensitic transformation temperature of steel and raises hardenability. However, when Mn assumes the case where a steel pipe is manufactured with electric resistance welding, it is easy to produce a weld flaw and 1.50% of the content is an upper limit.
Although nickel, Cr, and Mo are dramatically expensive compared with Mn, when compound addition is carried out, they are independent or the thing which martensitic transformation temperature is reduced, avoids a self temper, and demonstrates effectiveness by high intensity-ization about these [nickel, Cr and Mo] other than Mn. In order to secure weldability, an upper limit is made into 0.5%, respectively.
When manufacturing a steel pipe with electric resistance welding with Mn about Si, it is an element very important when maintaining the soundness of a weld zone. The upper limit of Si is made into 0.5% or less in order to make it not form the oxide called penetrator in a weld zone. It is desirable to set balance of a Mn/Si ratio to 3-10.
B is the element which raises hardenability by leaps and bounds, it is characterized by B addition in order to obtain 90% or more of martensite molar fractions with low [C] comparatively in the case of the steel type of this invention, but at less than 0.0003%, when the improvement effectiveness in hardenability is not acquired and it exceeds 0.0035%, it it not only becomes cost high, but tends to cause a surface crack and toughness degradation. Therefore, addition of B could be 0.0003 - 0.0035%.
Since the improvement effectiveness in hardenability of this B will be lost if 0.003% or more of N exists, it adds Ti for the object of immobilization of this N. If the amount of Ti to add exceeds 0.04%, generating of a crack, degradation of cutting ability, etc. will tend to produce a trouble in respect of quality, therefore Ti will regulate them to 0.04% or less.
In addition, N will exist in steel unescapable, will form BN, and will mitigate the effectiveness of B. Then, as for N, mitigating as much as possible is desirable, and it makes an upper limit 0.0080%.
Next, although it was the reason for definition of hot-rolling conditions, as a result of examining winding temperature in a detail in this invention, the result shown in drawing 3 was obtained.

After using the axis of abscissa into winding temperature from hot-rolling steel and using an axis of ordinate as an electroseamed steel pipe, it is a steel pipe strength property at the time of carrying out high-frequency-induction-hardening processing, and at the winding temperature of less than 600 degrees C, the variation in strong becomes very large. It is an example at the time of carrying out the same high-frequency-induction-hardening processing of the same component altogether, and although reinforcement when baking enters enough is not based on winding temperature but is almost fixed, winding temperature forms an organization inadequate in hardening selectively at less than 600 degrees C, its variation on the strength is large, and in order to be stabilized and to secure high intensity, it is unsuitable. Conversely, at the winding temperature of 600 degrees C or more, when the ferrite pearlite organization comparatively uniform in a hot-rolling steel phase and coarse is formed and tubulation after backing is put in, sufficient baking enters and a strength property with little variation is acquired.
Furthermore, hot-rolling steel is made into the winding temperature of 600 degrees C or more also from the tubulation nature in the case of considering as an electroseamed steel pipe. The tubulation nature said here points [ease / of carrying out / of handling of hot-rolling steel] out the ease of carrying out of electric resistance welding in the ease of carrying out of shaping. Although the start material of this invention has mitigated the carbon content as much as possible, since it makes hardenability high by addition of B etc., high intensity hot-rolling steel will be easily obtained by low temperature-ization of the winding temperature of hot-rolling. if it become high intensity steel, configuration destabilization of the electric resistance welding feed section which affect the difficulty of a fixed form, and the difficulty and the coincidence of shaping by buildup of shaping reaction force and buildup of the amount of buckling at electric resistance welding quality by lifting of the difficulty of handling, such as short period-izing of the life of the cutter in the case of the shearing work make into the steel strip for electroseamed steel pipes and lifting of winding and a rewind force, and the yield strength of an ingredient produce from hot-rolling steel, and welding quality stability will become difficult.
On the other hand, if winding temperature is made into 600 degrees C or more, electric resistance welding is possible in the condition which is the intensity level of a common electroseamed steel pipe as shown in drawing 4 that become 60 kgf(s)/mm about two to two hot-rolling steel 40 kgf(s)/mm, and it is not different from the usual electroseamed steel pipe. Furthermore, there is variation in raw material reinforcement as a factor which has an adverse effect on tubulation nature. The raw material for impact beams has many light-gage ingredients, and the temperature reduction after hot-rolling is comparatively quick. In the case of less than 600 degrees C, being easy to produce effect to winding temperature by the delicate difference among cooling conditions as a result, raw material reinforcement changes a lot corresponding to change of winding temperature, and has an adverse effect on the stability of shaping by subsequent tubulation, and a pan at the stability of electric resistance welding. Good tubulation nature is obtained by there being dramatically little variation range of the raw material reinforcement to winding temperature, and considering as the winding temperature of 600 degrees C or more above 600 degrees C, as shown in drawing 3 .
The hot-rolling steel manufactured on the above component and hot-rolling conditions is easy to consider as an electroseamed steel pipe, after considering as an electroseamed steel pipe, by carrying out high-frequency-induction-hardening processing, it is two or more 120 kgf/mm tensile strength, and is excellent in ductility and toughness, and shows the engine performance good as a car-body reinforcement electroseamed steel pipe.
(Example)
The example and the example of a comparison of this invention are shown in the 1st table. The heat treatment approach after using the JIS No. 5 tractive characteristics and the hot rolled sheet steel concerned of the hot rolled sheet steel by the manufacture approach of this invention as an electroseamed steel pipe with an outer-diameter [of 31.8mm] x thickness of 2.0mm and the JIS No. 11 tractive characteristics after heat treatment, and Charpy absorbed energy are collectively shown in the 1st table. Here, Charpy absorbed energy shows the data obtained with the full-sized test piece produced to dedication for toughness assessment.
In example A-F, with hot-rolling steel, in any case, it is 2 or less-about 60 kgf/mm tensile

strength, and it did not produce a big problem especially at the time of tubulation. After considering as an electroseamed steel pipe, by carrying out high-frequency-induction-hardening processing, in any case, 120 kgf(s)/a mm 2 or more and about 10% of elongation, and 2 or more-about absorbed energy 2 kgf-m/cm were obtained, and, moreover, the electroseamed steel pipe of the organization where the variation in tensile strength is as uniform as [or less / kgf/several mm] two was obtained.

The reinforcement of a policy objective is not obtained by high-frequency-induction-hardening processing when C content is lower than this invention component range, after using the example G of a comparison as an electroseamed steel pipe.

Although the example H of a comparison can be attained after high-frequency-induction-hardening processing of an electroseamed steel pipe and reinforcement can be enough attained by the case where the amount of C is higher than this invention component range, elongation is in a very low condition.

Although example I-M of a comparison is the case where low-temperature winding of less than 600 degrees C is carried out, and high intensity, high ductility, and high toughness can be comparatively attained as a property of a final electroseamed steel pipe, the variation on the strength cannot secure easily the property stabilized as those [20 kgf(s)/mm] about with two, and a car-body reinforcement steel pipe. Moreover, in a hot-rolling steel phase, it is high intensity and inferior by tubulation nature. When it usually considers as an electroseamed steel pipe with a line, it is difficult for the examples I, K, and L of a comparison to keep shear quality good, and the deficit of the round tooth of a shear process takes a special cure to them, when electroseamed-steel-pipe-izing. Moreover, the reinforcement of a raw material fell a little and, as for the examples J and M of a comparison, the comparatively good shear quality of a certain thing was acquired, as for the problem of the life of a shear round tooth. However, the difficulty [the steel strip point back end section] of handling and the reaction force in the case of electroseamed steel pipe shaping are high, loads, such as adjustment, increase in number and lowering of productivity is usually more remarkable than material on the strength.

第 1 表

（化学成分wt%）

													熱延鋼板			電縫鋼管						
鋼No.	C	Si	Mn	P	S	Ti	B	N	Al	Ni	Cr	Mo	巻取温度 (℃)	引張りさ kgf/mm²	造管性	焼入方法	ΔTS(N=5) バラツキ TS max－TS min	引張り強さ kgf/mm²	降伏強度 kgf/mm²	伸び %	vE－20 kgf－m/cm²	備考
A	0.16	0.18	1.12	0.018	0.004	0.022	0.0011	0.0051	0.026	－	0.22	－	620	52.0	○	高周波	6.2	135.2	102.5	17.0	7.9	本発明
B	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	－	0.23	－	620	53.0	○	高周波	4.3	158.0	115.0	16.0	5.9	本発明
C	0.22	0.21	1.18	0.018	0.004	0.021	0.0011	0.0045	0.028	－	0.22	－	650	58.0	○	高周波	5.2	163.2	122.5	13.0	4.0	本発明
D	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	0.50	0.20	0.2	620	55.0	○	高周波	3.7	159.0	112.0	17.0	6.9	本発明
E	0.18	0.20	1.15	0.016	0.004	0.021	0.0012	0.0053	0.024	－	0.40	0.2	650	59.0	○	高周波	4.5	158.5	114.0	16.0	5.7	本発明
F	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	0.50	－	－	650	55.0	○	高周波	2.2	155.0	109.0	18.0	7.1	本発明
G	0.14	0.19	1.13	0.017	0.004	0.022	0.0011	0.0051	0.026	－	0.22	－	650	48.0	○	高周波	8.5	110.5	90.2	19.0	8.3	比較例
H	0.27	0.21	1.18	0.018	0.004	0.021	0.0011	0.0045	0.028	－	0.22	－	650	58.0	○	高周波	10.2	172.2	130.5	7.0	1.5	比較例
I	0.22	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	－	0.23	－	200	142.0	×	高周波	19.5	158.0	121.0	11.0	3.3	比較例
J	0.21	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	400	95.0	△	高周波	21.0	150.1	123.3	11.5	3.2	比較例
K	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	30	140.0	×	高周波	23.5	143.5	109.5	11.5	4.9	比較例
L	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	200	139.0	×	高周波	21.5	142.2	107.2	11.0	4.0	比較例
M	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	400	95.0	△	高周波	18.0	149.5	105.5	12.0	2.7	比較例

vE－20：－20℃におけるシャルピー吸収エネルギー

(Effect of the invention)

As explained above, according to this invention, it is a with an excellent in elongation and toughness useful as a car-body reinforcement electroseamed steel pipe 120 kgf/mm tensile strength [or more 2] raw material for high intensity electroseamed steel pipes, and the hot-

rolling steel which does not change the workload at the time of moreover considering as an electroseamed steel pipe at all to the conventional low-strength material can be manufactured.

[Translation done.]

JAPANESE [JP,07-074382,B]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

TECHNICAL FIELD

(Field of the Invention)
Especially this invention relates to the manufacture approach of the hot-rolling steel materials for car-body reinforcement electroseamed steel pipes manufactured by the car-body reinforcement electroseamed steel pipe of which high intensity, such as a door impact bar which is a door reinforcement steel pipe for securing the safety of the car-body reinforcement steel pipe which needs high intensity, for example, the operator at the time of an automatic car side side collision, or a core material for bumpers, is required, especially high-frequency induction hardening.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

(Prior art)
It is required for the ingredient used as an automobile car-body reinforcement member, for example, an impact beam, to cause fracture and to make it reinforcement not fall rapidly, even if it receives big plastic deformation in that it is high intensity and coincidence at the time of a collision, and to secure this property also at low temperature because of safety reservation of the crew at the time of a collision. Thus, for an automobile car-body reinforcement member, reinforcement, ductility, and low-temperature toughness are important properties.
As the manufacture approach of a high intensity electroseamed steel pipe, the manufacture approach of the high tension electroseamed steel pipe indicated by JP,56-46538,B is learned. In order to secure ductility, temper processing had been performed, and generally quenching temper processing was required of this approach because of recovery of a steel pipe of toughness and ductility. However, since reinforcement would fall substantially if temper processing is performed, it was difficult to obtain the steel pipe of high intensity called two or more [120 kgf(s)/mm]. Although it is desirable to use it as [high-frequency-induction-hardening] when it is going to obtain this high-strength steel tubing, toughness deteriorates in this case. Then, although what is necessary is just to attain low carbon-ization if it is going to raise toughness as [high-frequency-induction-hardening], at this time, with the cooling rate at the time of high frequency quenching, the variation in strong becomes very large and a problem arises as practicability ability.

[Translation done.]

JAPANESE [JP,07-074382,B]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

EFFECT OF THE INVENTION

(Effect of the invention)
As explained above, according to this invention, it is a with an excellent in elongation and toughness useful as a car-body reinforcement electroseamed steel pipe 120 kgf/mm tensile strength [or more 2] raw material for high intensity electroseamed steel pipes, and the hot-rolling steel which does not change the workload at the time of moreover considering as an electroseamed steel pipe at all to the conventional low-strength material can be manufactured.

[Translation done.]

JAPANESE [JP,07-074382,B]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

TECHNICAL PROBLEM

(Technical problem which invention tends to solve)
This invention is made in order to solve problems, like that it faces manufacturing the steel pipe which needs high intensity, high toughness, and high ductility like the steel pipe for impact beams like the above, a low component is formed, and baking cannot enter easily when it is as [high frequency quenching] and uses it, and variation on the strength is large.

[Translation done.]

JAPANESE [JP,07-074382,B]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

MEANS

(The means for solving a technical problem)
The place made into the summary of this invention is C:0.15 - 0.25% (it is below the same% of the weight).
It is in the manufacture approach of the hot-rolling steel for car-body reinforcement electroseamed steel pipes manufactured by high-frequency induction hardening which contains Mn<=1.5%Si<=0.5%Ti<=0.04%B:0.0003-0.0035%N<=0.0080%, contains a nickel<=0.5%Cr<=0.5%Mo<=0.5% kind or two sorts or more further, is made from the steel which consists of the remainder Fe and an unescapable impurity, and is characterized by rolling round above 600 degrees C after hot rolling.

[Translation done.]

* NOTICES *

OPERATION

(Operation)
By having been made in order to solve the above-mentioned technical problem, and selecting a component and hot-rolling conditions, the tubulation nature of this invention at the time of considering as a welded tube after that is equivalent to the conventional low-strength steel pipe, and after considering as an electroseamed steel pipe, it offers the hot-rolling steel which can obtain the high intensity car-body reinforcement electroseamed steel pipe in which good elongation and toughness are shown by performing high-frequency-induction-hardening processing.
The reason for definition of the hot-rolling steel manufacture conditions in this invention is explained below.
First, although it is a component system, this invention is what aimed at the consolidation by quenching martensitic structure at the event of the car-body reinforcement electroseamed steel pipe of a final product, and the reinforcement of the martensitic structure of a quenching as is determined by C content. This is considered that the dissolution C introduced into supersaturation by utilization of a transformation causes rule. In order to secure 120 kgf(s)/mm two or more reinforcement desirable as an automobile car-body reinforcement electroseamed steel pipe, as shown in drawing 1 , 0.15% or more of C is required. On the other hand, an increase and degradation of ductility [carry out] become remarkable about the amount of C. In order to secure about 10% or more of elongation, C needs to consider as 0.25% or less. The toughness of the high-frequency-induction-hardening material to a carbon content is shown in drawing 2 . Toughness can be kept high less than [C0.25%].
As mentioned above, by investigating the effectiveness of a carbon content in a detail in this invention, it is 0.15% <= C<=0.25% of range, and the high intensity after high-frequency-induction-hardening processing, and high toughness and high ductility can be attained, and the effective property as a car-body reinforcement electroseamed steel pipe is acquired.
Mn is the element which can have the effectiveness which avoids the self temper after a transformation in the middle of quenching treatment, and keeps reinforcement high while it reduces the martensitic transformation temperature of steel and raises hardenability. However, when Mn assumes the case where a steel pipe is manufactured with electric resistance welding, it is easy to produce a weld flaw and 1.50% of the content is an upper limit.
Although nickel, Cr, and Mo are dramatically expensive compared with Mn, when compound addition is carried out, they are independent or the thing which martensitic transformation temperature is reduced, avoids a self temper, and demonstrates effectiveness by high intensity-ization about these [nickel, Cr and Mo] other than Mn. In order to secure weldability, an upper limit is made into 0.5%, respectively.
When manufacturing a steel pipe with electric resistance welding with Mn about Si, it is an element very important when maintaining the soundness of a weld zone. The upper limit of Si is made into 0.5% or less in order to make it not form the oxide called penetrator in a weld zone. It is desirable to set balance of a Mn/Si ratio to 3-10.
B is the element which raises hardenability by leaps and bounds, it is characterized by B addition in order to obtain 90% or more of martensite molar fractions with low [C] comparatively in the

case of the steel type of this invention, but at less than 0.0003%, when the improvement effectiveness in hardenability is not acquired and it exceeds 0.0035%, it it not only becomes cost high, but tends to cause a surface crack and toughness degradation. Therefore, addition of B could be 0.0003 - 0.0035%.
Since the improvement effectiveness in hardenability of this B will be lost if 0.003% or more of N exists, it adds Ti for the object of immobilization of this N. If the amount of Ti to add exceeds 0.04%, generating of a crack, degradation of cutting ability, etc. will tend to produce a trouble in respect of quality, therefore Ti will regulate them to 0.04% or less.
In addition, N will exist in steel unescapable, will form BN, and will mitigate the effectiveness of B. Then, as for N, mitigating as much as possible is desirable, and it makes an upper limit 0.0080%.
Next, although it was the reason for definition of hot-rolling conditions, as a result of examining winding temperature in a detail in this invention, the result shown in drawing 3 was obtained. After using the axis of abscissa into winding temperature from hot-rolling steel and using an axis of ordinate as an electroseamed steel pipe, it is a steel pipe strength property at the time of carrying out high-frequency-induction-hardening processing, and at the winding temperature of less than 600 degrees C, the variation in strong becomes very large. It is an example at the time of carrying out the same high-frequency-induction-hardening processing of the same component altogether, and although reinforcement when baking enters enough is not based on winding temperature but is almost fixed, winding temperature forms an organization inadequate in hardening selectively at less than 600 degrees C, its variation on the strength is large, and in order to be stabilized and to secure high intensity, it is unsuitable. Conversely, at the winding temperature of 600 degrees C or more, when the ferrite pearlite organization comparatively uniform in a hot-rolling steel phase and coarse is formed and tubulation after backing is put in, sufficient baking enters and a strength property with little variation is acquired.
Furthermore, hot-rolling steel is made into the winding temperature of 600 degrees C or more also from the tubulation nature in the case of considering as an electroseamed steel pipe. The tubulation nature said here points [ease / of carrying out / of handling of hot-rolling steel] out the ease of carrying out of electric resistance welding in the ease of carrying out of shaping.
Although the start material of this invention has mitigated the carbon content as much as possible, since it makes hardenability high by addition of B etc., high intensity hot-rolling steel will be easily obtained by low temperature-ization of the winding temperature of hot-rolling. if it become high intensity steel, configuration destabilization of the electric resistance welding feed section which affect the difficulty of a fixed form, and the difficulty and the coincidence of shaping by buildup of shaping reaction force and buildup of the amount of buckling at electric resistance welding quality by lifting of the difficulty of handling, such as short period-izing of the life of the cutter in the case of the shearing work make into the steel strip for electroseamed steel pipes and lifting of winding and a rewind force, and the yield strength of an ingredient produce from hot-rolling steel, and welding quality stability will become difficult.
On the other hand, if winding temperature is made into 600 degrees C or more, electric resistance welding is possible in the condition which is the intensity level of a common electroseamed steel pipe as shown in drawing 4 that become 60 kgf(s)/mm about two to two hot-rolling steel 40 kgf(s)/mm, and it is not different from the usual electroseamed steel pipe.
Furthermore, there is variation in raw material reinforcement as a factor which has an adverse effect on tubulation nature. The raw material for impact beams has many light-gage ingredients, and the temperature reduction after hot-rolling is comparatively quick. In the case of less than 600 degrees C, being easy to produce effect to winding temperature by the delicate difference among cooling conditions as a result, raw material reinforcement changes a lot corresponding to change of winding temperature, and has an adverse effect on the stability of shaping by subsequent tubulation, and a pan at the stability of electric resistance welding. Good tubulation nature is obtained by there being dramatically little variation range of the raw material reinforcement to winding temperature, and considering as the winding temperature of 600 degrees C or more above 600 degrees C, as shown in drawing 3 .
The hot-rolling steel manufactured on the above component and hot-rolling conditions is easy to

consider as an electroseamed steel pipe, after considering as an electroseamed steel pipe, by carrying out high-frequency-induction-hardening processing, it is two or more 120 kgf/mm tensile strength, and is excellent in ductility and toughness, and shows the engine performance good as a car-body reinforcement electroseamed steel pipe.

[Translation done.]

* NOTICES *

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EXAMPLE

(Example)
The example and the example of a comparison of this invention are shown in the 1st table. The heat treatment approach after using the JIS No. 5 tractive characteristics and the hot rolled sheet steel concerned of the hot rolled sheet steel by the manufacture approach of this invention as an electroseamed steel pipe with an outer-diameter [of 31.8mm] x thickness of 2.0mm and the JIS No. 11 tractive characteristics after heat treatment, and Charpy absorbed energy are collectively shown in the 1st table. Here, Charpy absorbed energy shows the data obtained with the full-sized test piece produced to dedication for toughness assessment.
In example A-F, with hot-rolling steel, in any case, it is 2 or less-about 60 kgf/mm tensile strength, and it did not produce a big problem especially at the time of tubulation. After considering as an electroseamed steel pipe, by carrying out high-frequency-induction-hardening processing, in any case, 120 kgf(s)/a mm 2 or more and about 10% of elongation, and 2 or more-about absorbed energy 2 kgf-m/cm were obtained, and, moreover, the electroseamed steel pipe of the organization where the variation in tensile strength is as uniform as [or less / kgf/several mm] two was obtained.
The reinforcement of a policy objective is not obtained by high-frequency-induction-hardening processing when C content is lower than this invention component range, after using the example G of a comparison as an electroseamed steel pipe.
Although the example H of a comparison can be attained after high-frequency-induction-hardening processing of an electroseamed steel pipe and reinforcement can be enough attained by the case where the amount of C is higher than this invention component range, elongation is in a very low condition.
Although example I-M of a comparison is the case where low-temperature winding of less than 600 degrees C is carried out, and high intensity, high ductility, and high toughness can be comparatively attained as a property of a final electroseamed steel pipe, the variation on the strength cannot secure easily the property stabilized as those [20 kgf(s)/mm] about with two, and a car-body reinforcement steel pipe. Moreover, in a hot-rolling steel phase, it is high intensity and inferior by tubulation nature. When it usually considers as an electroseamed steel pipe with a line, it is difficult for the examples I, K, and L of a comparison to keep shear quality good, and the deficit of the round tooth of a shear process takes a special cure to them, when electroseamed-steel-pipe-izing. Moreover, the reinforcement of a raw material fell a little and, as for the examples J and M of a comparison, the comparatively good shear quality of a certain thing was acquired, as for the problem of the life of a shear round tooth. However, the difficulty [the steel strip point back end section] of handling and the reaction force in the case of electroseamed steel pipe shaping are high, loads, such as adjustment, increase in number and lowering of productivity is usually more remarkable than material on the strength.

第　　1　　表

（化学成分wt%）

													熱延鋼板			電縫鋼管						
鋼No.	C	Si	Mn	P	S	Ti	B	N	Al	Ni	Cr	Mo	巻取温度 (℃)	引張強さ kgf/mm²	造管性	焼入方法	ΔTS(N=5) バラツキ TS max－TS min	引張り強さ kgf/mm²	降伏強度 kgf/mm²	伸び %	vE－20 kgf－m/cm²	備考
A	0.16	0.18	1.12	0.018	0.004	0.022	0.0011	0.0051	0.026	－	0.22	－	620	52.0	○	高周波	6.2	135.2	102.5	17.0	7.9	本発明
B	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	－	0.23	－	620	53.0	○	高周波	4.3	158.0	115.0	16.0	5.9	本発明
C	0.22	0.21	1.18	0.018	0.004	0.021	0.0011	0.0045	0.028	－	0.22	－	650	58.0	○	高周波	5.2	163.2	122.5	13.0	4.0	本発明
D	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	0.50	0.20	0.2	620	55.0	○	高周波	3.7	159.0	112.0	17.0	6.9	本発明
E	0.18	0.20	1.15	0.016	0.004	0.021	0.0012	0.0053	0.024	－	0.40	0.2	650	59.0	○	高周波	4.5	158.5	114.0	16.0	5.7	本発明
F	0.18	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	0.50	－	－	650	55.0	○	高周波	2.2	155.0	109.0	18.0	7.1	本発明
G	0.14	0.19	1.13	0.017	0.004	0.022	0.0011	0.0051	0.026	－	0.22	－	650	48.0	○	高周波	8.5	110.5	90.2	19.0	8.3	比較例
H	0.27	0.21	1.18	0.018	0.004	0.021	0.0011	0.0045	0.028	－	0.22	－	650	58.0	○	高周波	10.2	172.2	130.5	7.0	1.5	比較例
I	0.22	0.20	1.15	0.016	0.003	0.021	0.0012	0.0053	0.024	－	0.23	－	200	142.0	×	高周波	19.5	158.0	121.0	11.0	3.3	比較例
J	0.21	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	400	95.0	△	高周波	21.0	150.1	123.3	11.5	3.2	比較例
K	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	30	140.0	×	高周波	23.5	143.5	109.5	11.5	4.9	比較例
L	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	200	139.0	×	高周波	21.5	142.2	107.2	11.0	4.0	比較例
M	0.18	0.21	1.16	0.016	0.003	0.026	0.0012	0.0048	0.021	－	－	－	400	95.0	△	高周波	18.0	149.5	105.5	12.0	2.7	比較例

vE－20：－20℃におけるシャルピー吸収エネルギー

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
As for drawing 1 , for drawing showing the effect to the tensile strength of an electroseamed steel pipe final [after high-frequency-induction-hardening processing], and Charpy impact value, drawing showing the effect of winding temperature conditions of as opposed to the strength property after high-frequency induction hardening in drawing 3 , and drawing 4 , the carbon content of hot-rolling steel of drawing showing the effect to the tractive characteristics of an electroseamed steel pipe final [after high-frequency-induction-hardening processing] and drawing 2 is [the carbon content of hot-rolling steel] drawing showing the effectiveness over the tensile strength of the hot-rolling steel of winding temperature.

[Translation done.]

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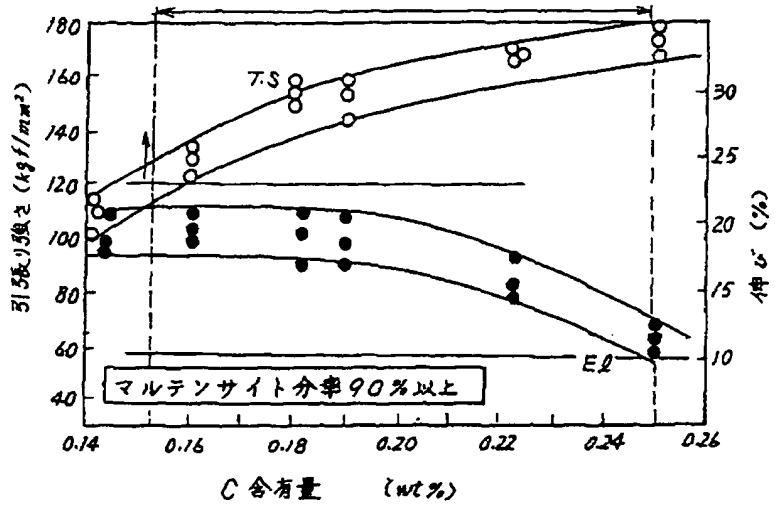
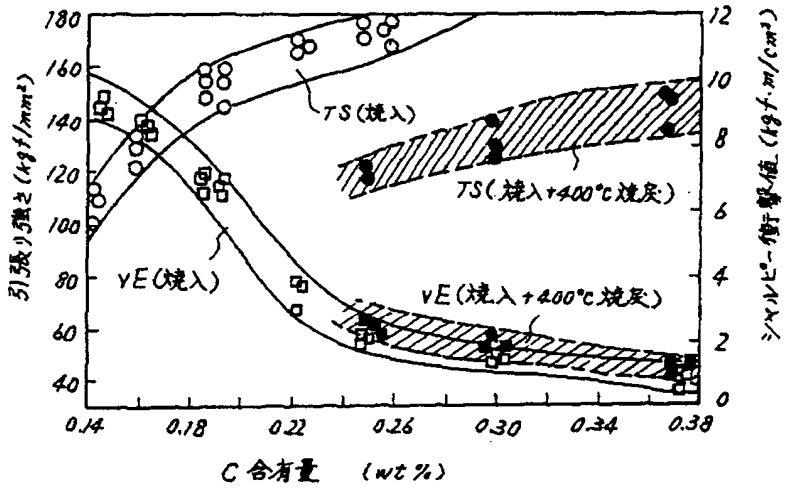
DRAWINGS

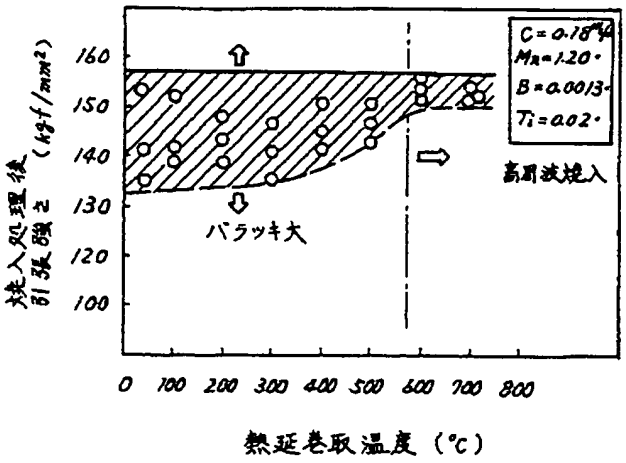
[Drawing 1]



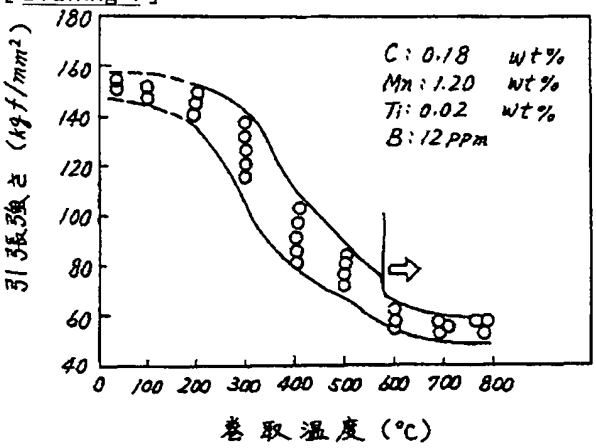
[Drawing 2]



[Drawing 3]

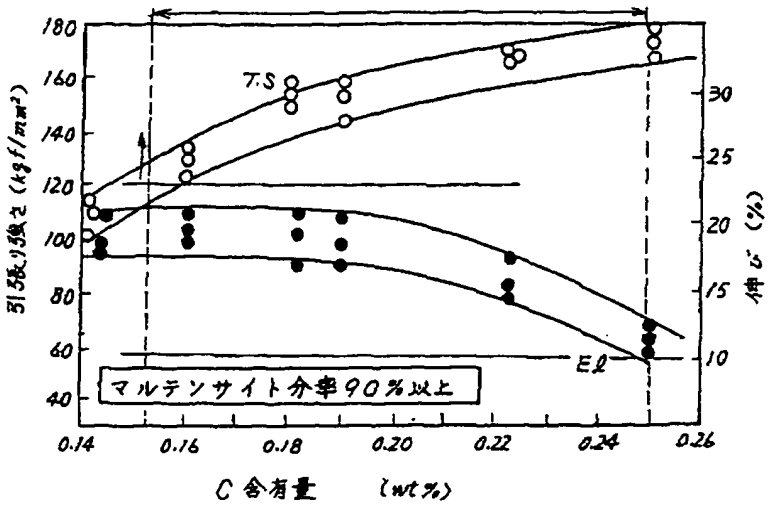


[Drawing 4]



[Translation done.]

Drawing selection Drawing 1



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